

TIGER REALM

A SCIENCE 3D ADVENTURE

MIDDLE SCHOOL



By MIKE HEITHAUS Ph.D

symbioeducation™

KEY WORDS

ARTIFICIAL INTELLIGENCE

BIOME

DIURNAL

EXTINCTION

FERAL

GENETIC VARIATION

GENETICS

HYBRID

MIGRATE

NATIVE

QUALITY ASSURANCE

QUALITY CONTROL

SEMIARID DESERT

SOLITARY

TERRITORY

TRAIT

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CATS!

When you think of a cat, what comes to mind? It is likely a domestic cat that lives with people. Scientists estimate that there are between 200 to 600 million cats on Earth, but not all are pets. House cats are just one of more than 24 species of cats found all over the world. They range in size from the one kilogram (two pound) rusty-spotted cat to the Siberian tiger, which can weigh up to 300 kilograms (660 pounds).

Rusty-spotted cat
Prionailurus rubiginosus
India, Sri Lanka, Nepal



Siberian tiger
Panthera tigris tigris
Russia, China



Cats can get even bigger than Siberian tigers, but only when there is a **hybrid** between two different species. When a male lion mates with a female tiger, a liger is produced. Ligers are enormous. The largest recorded liger was 550 kilograms (1,200 pounds)! Tigons are the offspring of a male tiger and a female lion. Instead of being huge, they are smaller than both their parents. Why are there such differences in sizes of the two hybrids? It's all about **genetics**. For a liger, the male lion passes on a gene that promotes growth. The female tiger, however, does not have a growth-inhibiting gene that a female lion would pass on to the cub. That means ligers can grow really big. For a tigon, the male lion doesn't pass along a growth-promoting gene, but the cub gets a growth-inhibiting gene from the female lion. This slows the tigon's growth. Some people think that ligers and tigons may have occurred in nature many years ago. But, with the decreased ranges of tigers and lions, they don't encounter each other in nature. Their hybrids are only found in captivity today.



A liger, a lion-tiger hybrid, cannot reproduce. Zoos that breed tigers to help with conservation make sure that there are never hybrids. They also don't breed different types of tigers with each other. This preserves the unique genetics of each type of tiger.

Some prehistoric cats were bigger than tigers. Scientists think that the saber tooth tiger (*Smilodon populator*), which is only distantly related to today's living cats, was the largest cat species to walk the Earth. One skull that was found belonged to a cat that was probably 430 kilograms (950 pounds)!



All cats are predators. They eat other animals. Cats have strong muscles, big brains, claws, and incredible senses of smell, hearing and touch. These **traits** all help them find and catch prey. Tigers can take down large prey like deer and guar. Domesticated housecats are also fierce predators. It is estimated that both pet and **feral** housecats, kill between 1.4 and 3.7 billion birds and 6.9 and 20.7 billion small mammals in the United States annually. That is enough to cause populations of some of these species to decline. There are no cats **native** to Australia. But Australian feral cats are the biggest threat to the survival of many native species. Scientists estimate that feral cats have already caused the **extinction** of 20 species of Australian mammals and threaten over 100 more species of mammals, birds, reptiles and amphibians with extinction. Pet cats should be kept inside!



Wildlife has suffered greatly from the introduction of non-native housecats. For example, many native Australian animal populations, especially mammals like numbats, are at risk of extinction.

Cats are impressive predators, but most species of cats aren't at the very top of the food chain. Most cat species are relatively small and have to watch out for eagles, coyotes, wolves, dogs, bigger cats, and hyenas that might eat them. A few species, like jaguars, lions, and tigers are top predators.

THE BIGGEST CAT

You are going to help with an investigation of Indian tigers (also called Bengal tigers). While there is just one species of tiger (*Panthera tigris*), there are nine different types of tigers that were alive in the last century. Each type has slight differences because each adapted to different climates and conditions. The different types have not bred with one another in the wild for many, many generations. Overall, tigers are now found in less than 50% of the area they used to occupy. Three of the nine tiger types have gone extinct since the 1940s.

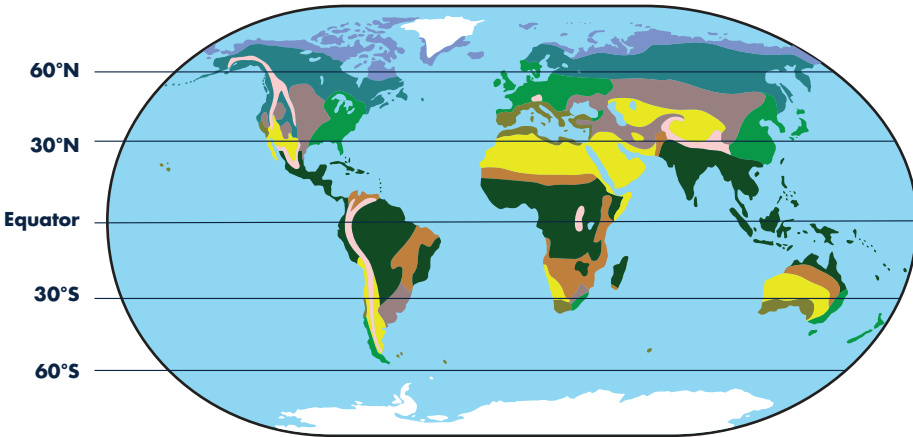


Historically, tigers were found over much of Asia. Their range has declined dramatically and continues to shrink today. Three types of tigers have already gone extinct: the Caspian tiger, the Javan Tiger, and the Bali tiger.

CATS, CATS, EVERYWHERE

Cats occur naturally in almost every **biome** on the planet and on all continents except for Antarctica and Australia. Cats aren't naturally found in Australia because it is an island that has been separated from other continents for so long.

Biomes are the different types of major ecosystems on the planet. They each have a different pattern of precipitation, temperature, and seasonal changes. Every biome is dominated by a particular kind of plant, or groups of plants, that survive well in these conditions. Let's have a look at the different biomes and some of the cats that live in them.



- Polar ice
- High mountains
- Temperate forest
- Chaparral
- Desert
- Tundra
- Taiga (boreal forest)
- Temperate grassland
- Savanna
- Tropical forest



EARTH'S BIOMES

Tundra:

The conditions in the tundra are harsh! It is below freezing almost all year and there is very little precipitation. The precipitation is usually snow. Small or hearty plants grow during the brief time it is above freezing. No cats live in the tundra. This biome is for caribou, wolves, and polar bears!



High Mountains:

Tundra-like conditions can occur in the high mountains. At this elevation it is cold and doesn't rain much. But there are a lot of boulders and rocks where cats can hide. Snow leopards are found in these cold habitats where there is enough prey!



Snow leopard



Taiga (Boreal Forests):

These huge expanses of forest are found mainly in the northern hemisphere across Canada and Russia. Winters are long and summers are short, but there is enough water for pine forests. There is also enough food for elk, moose, and caribou. Canada lynx and Siberian tigers call this snowy habitat home.



Siberian tiger



Canada lynx



Temperate Rainforests:

These forests don't have long and snowy winters, but they are cool in the summer. The great amount of rain they experience makes trees grow extremely tall. In North America, mountain lions are top predators in this biome.



Mountain lion

Temperate Forests:

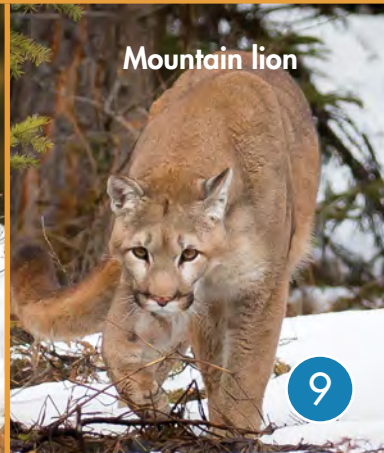
This biome has seasons with cold and often snowy winters, rainy springs, and warm summers. In deciduous forests, trees lose their leaves in the winter. In evergreen forests, pine trees keep their needles all year. In North America, mountain lions and bobcats can be found in temperate forests. In Asia, they are home to leopards.



Asian leopard



Bobcat



Mountain lion

Temperate Grasslands:

Also called prairies or steppes, these dry grasslands have cold winters. Prairie dogs are famous inhabitants of temperate grasslands in the United States. Caspian tigers once inhabited this biome in Asia. Today, Pallas's cats live there. In African grasslands, cheetahs or caracals may be found.



Pallas's cat



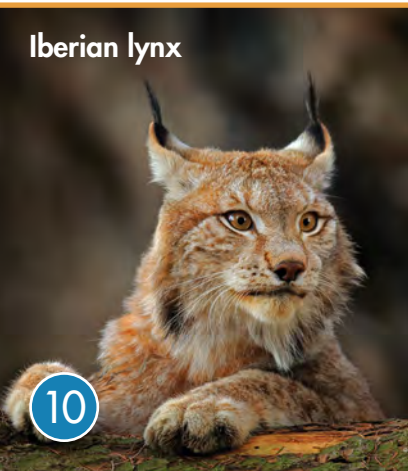
Cheetah



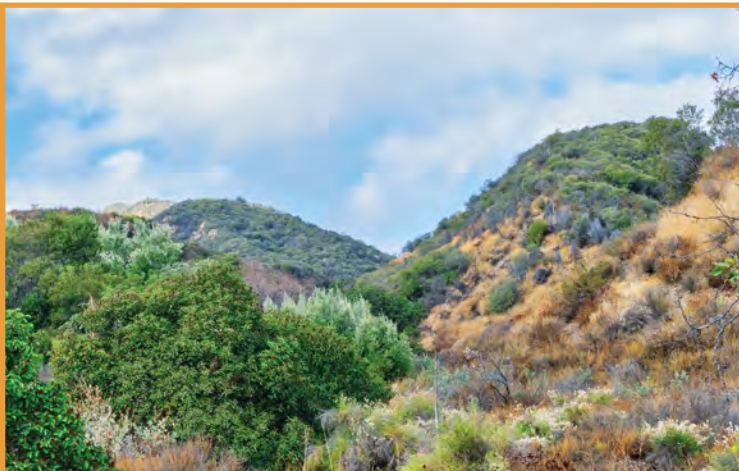
Caracal

Chaparral:

This biome is dominated by shrubs and bushes. They are warm and dry in the summer and cool and mild in the winter. Mountain lions and the Iberian lynx are two cats found in this habitat.



Iberian lynx



Savannas:

This biome consists of tropical grasslands with scattered trees. There is not enough rain for forests to grow. It is warm or hot all year. There is plenty of water during the rainy season, but dry seasons can make it tough for animals to find water. Because of this, some herbivores on savannas have to **migrate** to find food and water. Lions, cheetahs, tigers, and many smaller cat species call the savanna home.



Bengal tiger



Cheetah

Serval



African lion



African lion

Deserts:

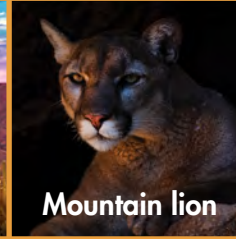
There is very little precipitation in deserts. The sand cat is specialized for the deserts of Africa, the Middle East, and Central Asia. It can survive weeks without drinking. It gets the water it needs from its prey. In **semiarid deserts** of the Americas, mountain lions, ocelots, and bobcats can be found.



Sand cat



Ocelot



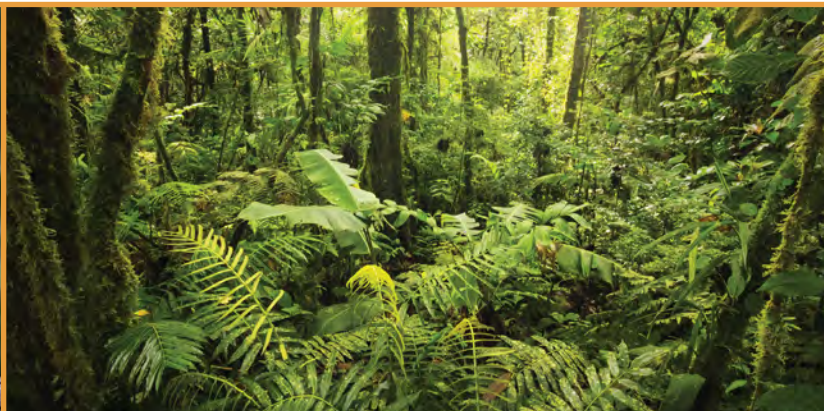
Mountain lion

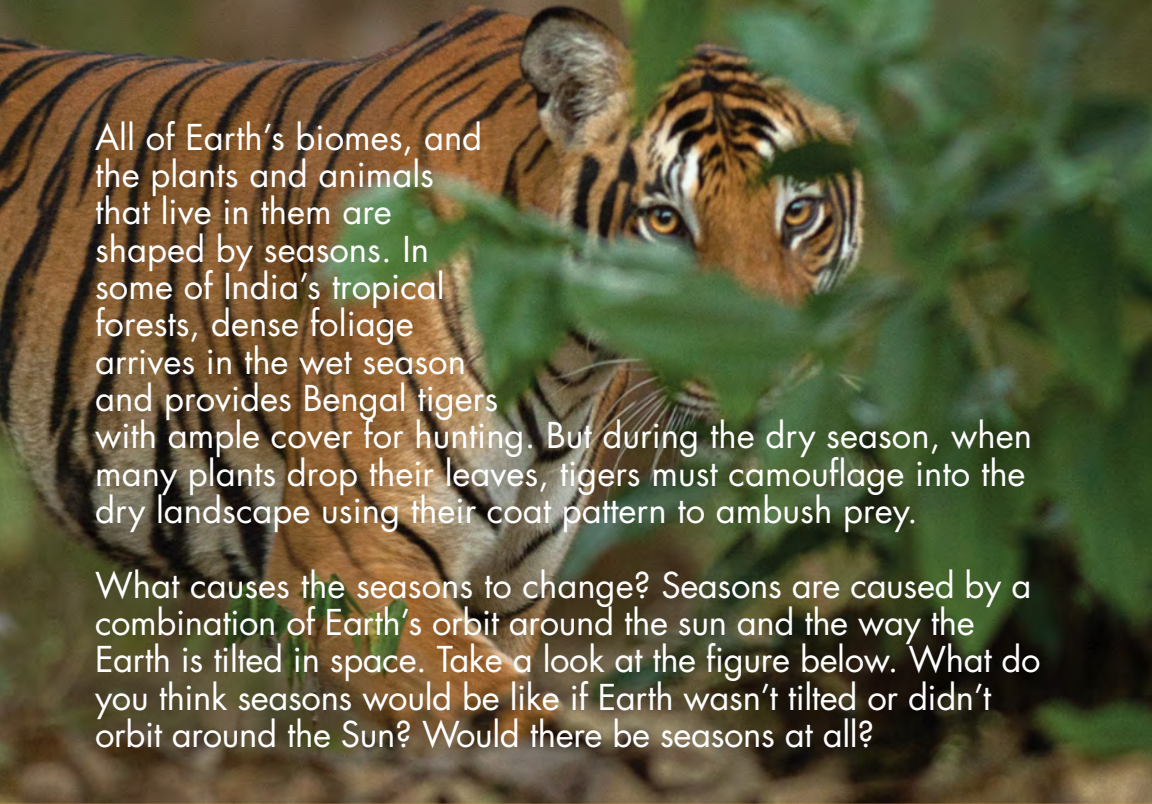
Tropical Forests:

In most tropical forests the temperatures do not change much throughout the year. There is ample rain for plants to grow year-round. In some tropical forests, called dry forests, there are distinct wet and dry seasons. In the wet season, forests are very lush. In the dry season, some trees lose their leaves. Many cat species live in tropical forests, including jaguars, jaguarundi, ocelots, leopards, and tigers.



Jaguar





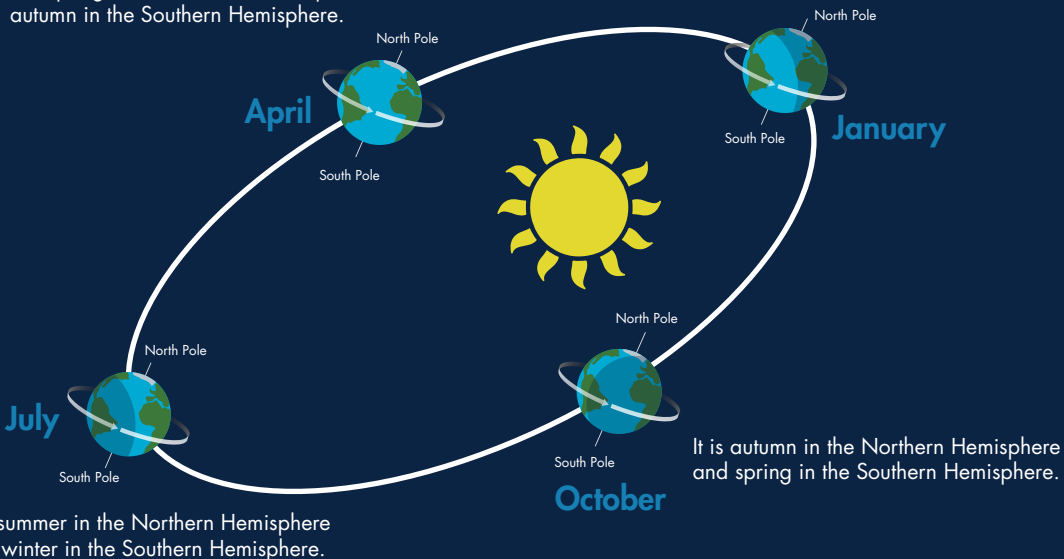
All of Earth's biomes, and the plants and animals that live in them are shaped by seasons. In some of India's tropical forests, dense foliage arrives in the wet season and provides Bengal tigers with ample cover for hunting. But during the dry season, when many plants drop their leaves, tigers must camouflage into the dry landscape using their coat pattern to ambush prey.

What causes the seasons to change? Seasons are caused by a combination of Earth's orbit around the sun and the way the Earth is tilted in space. Take a look at the figure below. What do you think seasons would be like if Earth wasn't tilted or didn't orbit around the Sun? Would there be seasons at all?

EARTH'S ORBIT AND THE SEASONS

It is spring in the Northern Hemisphere and autumn in the Southern Hemisphere.

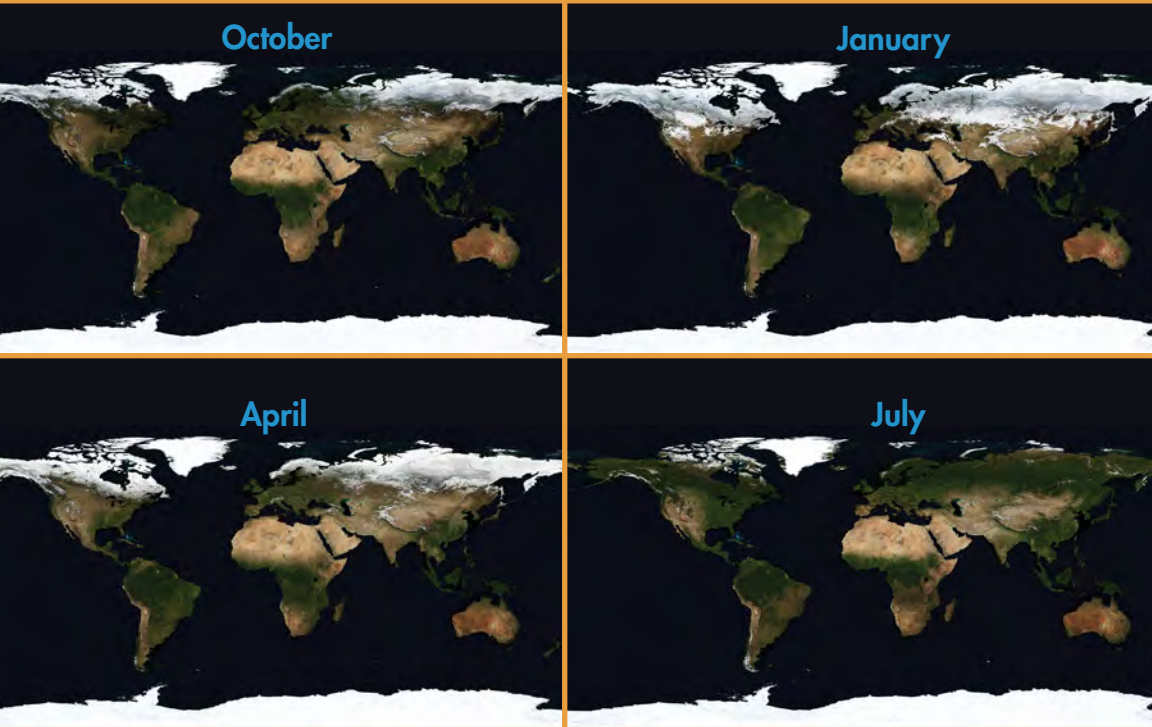
It is winter in the Northern Hemisphere and summer in the Southern Hemisphere.



Earth's seasons are a result of its orbit around the Sun and its tilt. The Northern and Southern Hemispheres experience more direct sunlight during their summer months, but at opposite times of year. Both the North and South Poles get 24 hours of sunlight during their summers!

WHY THERE?

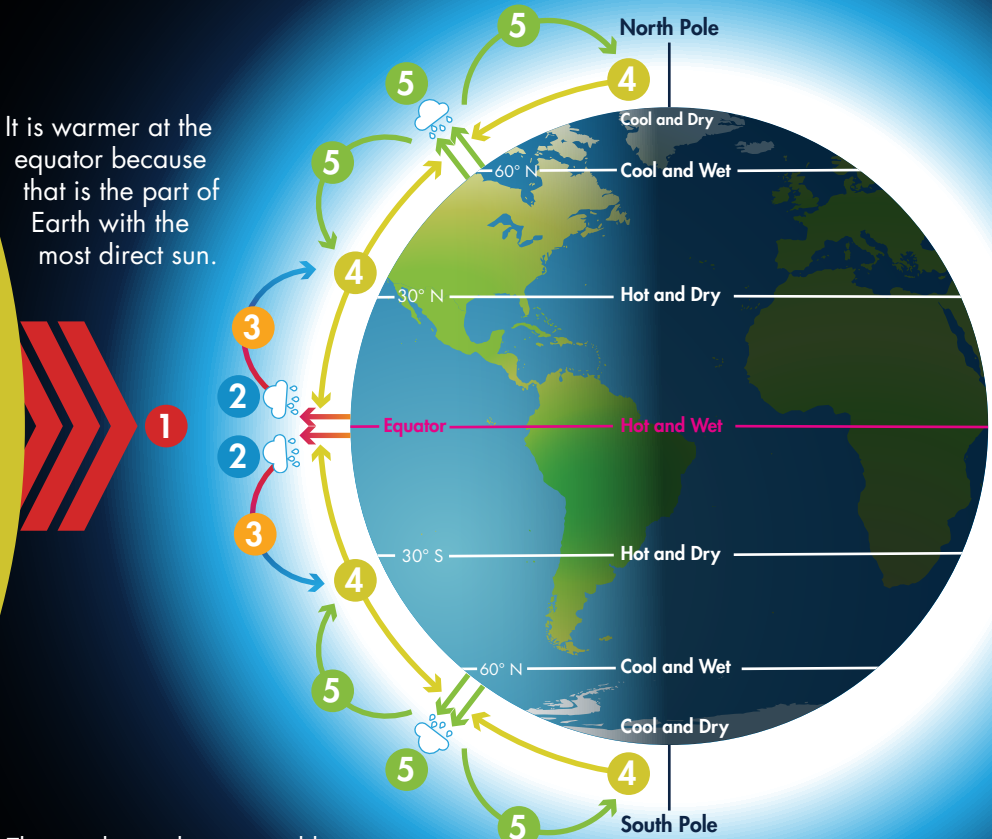
Look at the satellite images of Earth during different times of year. What do you notice about the amount of green plant life and white ice and snow in different areas? What areas seem to change the most between Earth's seasons?



Why do particular regions have different climates? Why are biomes found in particular places? What influences the seasonal changes in particular areas?

Regional climates and biomes are influenced by several important factors. These include latitude, prevailing winds, distance from the ocean, ocean currents, landforms and elevation. Let's investigate!

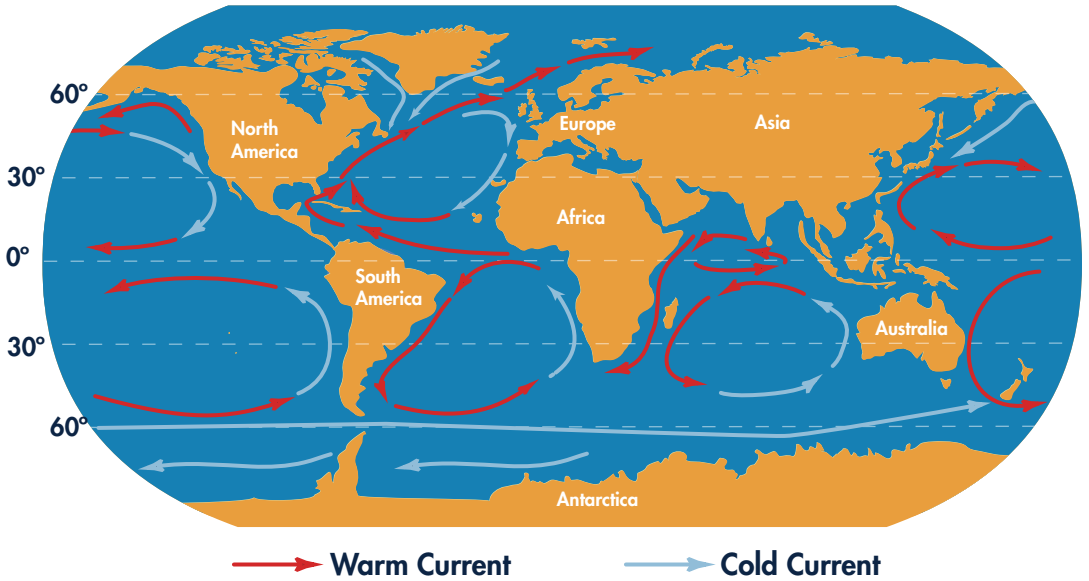
Latitude: Areas close to the equator have warmer climates because the sun hits them more directly. Rainfall is high near the equator and near 60 degrees north and south because air rises at these points. As the air rises, it loses its moisture through precipitation. The air falls to the surface of the earth near 30 degrees north and south and at the poles. There is little moisture at these locations.



- 1 The sun heats the air, and hot air rises.
- 2 As the air rises, it cools and loses moisture as rain.
- 3 The cool, dry air moves north and south until it sinks back to Earth at 30° N and S.
- 4 Air moves across Earth to fill in places where air is rising.
- 5 At 60° N and S, wet air rises and drops its water as precipitation. By the time it reaches 30° N and S and the poles, the dry air sinks.

Ocean currents and prevailing winds: Oceans absorb heat from sunlight and then release it slowly. Surface winds create ocean currents that move the heat around the globe. This results in warm waters from the equator moving north and south along the east coasts of continents and cooler water from near the poles moving south and north along west coasts of continents. In locations where winds blow from offshore towards the land, moisture is brought onshore.

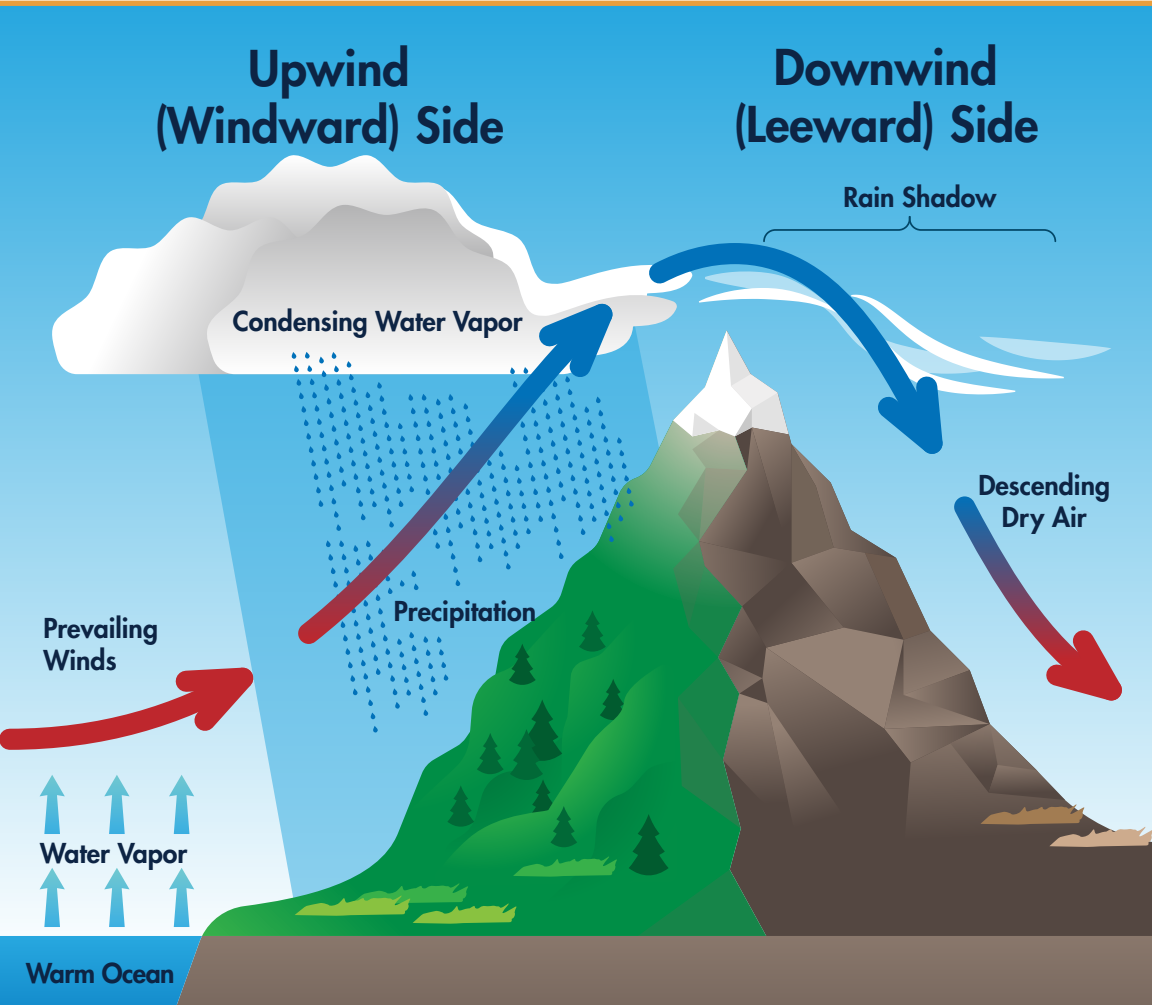
OCEAN CURRENTS



Baja California, Mexico (left) is on the cold Pacific Ocean. Florida, United States (right) is on the warm Atlantic Ocean. Both locations share the same latitude near the tropics, but their biomes and climates differ drastically because of their ocean currents and winds.

Distance from ocean and presence of mountains:

Because water absorbs energy and releases it more slowly than land, areas near the coast tend to have more moderate climates.



Above: As air rises, it cools and loses moisture as precipitation. This causes regions on the upwind side of mountains to have wet climates. As winds force air up and over the mountains, the air cools and it rains or snows. On the downwind side, there is little precipitation. In the Patagonia region of South America, this can be clearly seen in the Andes Mountains. Bottom left: The west (windward) side is lush and wet. Bottom right: The east (leeward) side is dry and barren.



TIGER LIFE



Tigers live in home ranges that contain the resources they need to survive and reproduce. The size of home ranges can be very different depending on the conditions. Some tigers may only travel over tens of square kilometers.

Others may range over thousands of square kilometers. Tigers don't defend all of the area they travel across. But, at the core of their home range, they have **territories** that they defend from other tigers. Female tigers often don't defend their territories. Males, however, defend them from other males. They mark the edges of their territory with urine and feces and by scratching trees. These markings warn possible intruders. Young males tend to live a transient life, avoiding territorial males. They create a territory where there is no other male or, once they are big enough, they try to take a territory from another male.

Tigers are generally **solitary**, although multiple females and cubs may feed from the same carcass. Males also allow females and cubs in their territory to feed on their prey.



You may have heard that cats don't like water, but that isn't true of tigers! They are quite at home in the water and can even swim across lakes and very broad rivers.

GROWING UP TIGER

Tiger mothers are pregnant for about three and a half months before giving birth. They usually have two to three cubs at a time. Tiger cubs are fairly helpless when they are born, so their mother finds a sheltered place to stay while the cubs are young. Cubs' eyes open after a week or two. They rely completely on milk for food until they are about eight weeks old when they start to eat meat. But, they will continue to drink milk for five to six months. Even though they don't count on milk for food at that point, tiger cubs still need their mother for protection. The young tigers follow their mother as she walks around her home range. They learn to hunt by watching her. They also roughhouse with each other to develop survival skills. Tiger cubs usually stay with their mother for about two years. Once they are independent they move on to establish their own home ranges.



Play fighting helps tiger cubs develop skills they will need later on in life.

TIGER MENU

Tigers are usually **diurnal**, meaning they are active and hunt during the day. Most of the time, tigers hunt and eat prey like deer and wild boar. Sometimes tigers hunt very large prey like gaur, which are also known as Indian bison. Occasionally, they hunt smaller prey like monkeys, rabbits, peacocks, and even porcupines.



Bengal tiger with deer kill



Gaur



Indian porcupine



Tigers are strong and efficient predators. They are capable of taking down very large prey, like gaur, or Indian bison. But hunting can be dangerous. A tiger hungry or curious enough to pursue a porcupine can end up with a face full of quills!

TIGER HOME

The Nilgiri Biosphere reserve is a protected area in Southern India where wild tigers thrive. It contains tropical forests with two distinct seasons. In the wet season, there is ample rainfall and the forest is lush, dense, and green. During the dry season, the rain stops, vegetation dries out, and most trees drop their leaves. Even though it is dry, enough water remains in the rivers, lakes, and ponds for animals to survive.



Indian elephants love to spend time in the water!



Dholes (Asiatic wild dogs)



Striped hyena



Tigers are the top predator in the forests of the Nilgiri Biosphere Reserve, but they have to compete with other large predators including bears, leopards, hyenas, crocodiles and Asiatic wild dogs, called dholes. Tigers can usually dominate these predators, but a large group of dholes may be able to steal a tiger's kill. A large crocodile may also occasionally come out on top.

Sloth bear



Leopard



Mugger crocodile



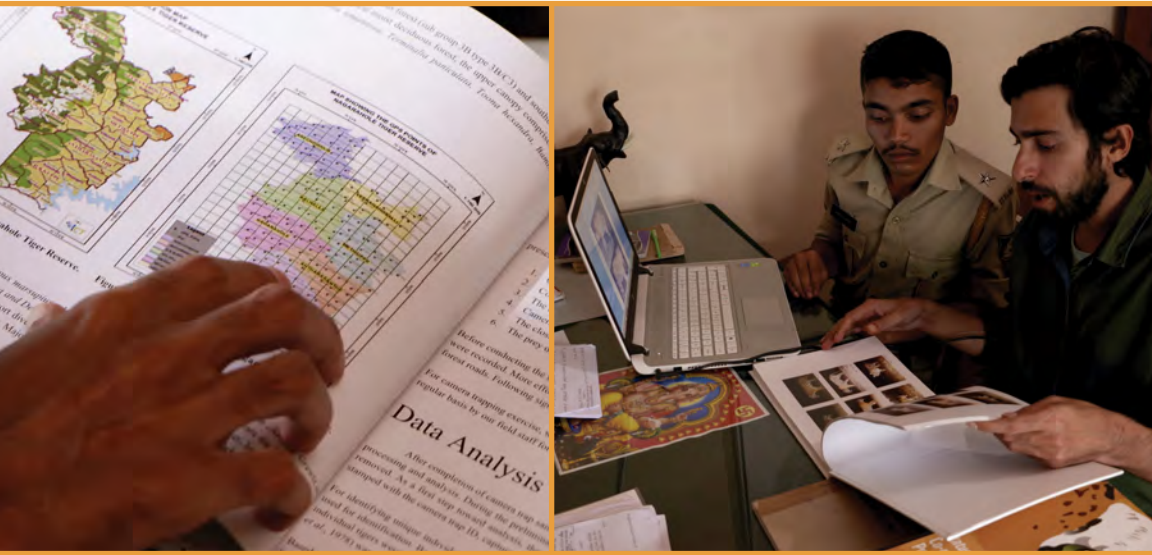
TIGERS IN TROUBLE



People used to hunt tigers for trophies like their skins or teeth. Today, it is illegal to kill tigers. In some places, tigers are still hunted because people wrongly think their body parts can be used as medical cures. Since some people will pay for them, poaching is a big problem for tigers. Tigers face other dangers and challenges throughout their range. Some threats are direct. People are afraid of tigers because they can be dangerous and can kill their livestock. Because of this, tigers were hunted heavily and their populations were reduced. Other threats are indirect. Populations of their prey are decreasing in some areas. That means the habitat can support fewer tigers. These tigers may die if they don't move or find bigger ranges. The loss of habitat to development for towns or agriculture is a big problem, and collisions with vehicles are on the rise. Finally, people are cutting down tiger habitats to mine natural resources. Since tigers are big and need a lot of prey, they need enough intact habitat to survive.



SAVING TIGERS



People around the world are trying to save tigers. Governments have protected areas, like the Nilgiri Biosphere Reserve, to provide wild tigers with enough intact habitat to survive and thrive. But in many places, this has not been enough. People are working to reduce the poaching and hunting of tigers. In some cases, where populations are too small to survive in the wild, zoos are helping. By working together, zoos breed tigers in captivity to ensure that there is enough **genetic variation** in the population. The hope is that once wild habitats are protected or restored, some of these tigers in zoos can be used to re-establish wild populations.

The key to saving tigers requires learning more about them and their ecosystems. Even though tigers are large animals, they are extremely difficult to see in the wild. This makes studying them very challenging. Scientists use several techniques to study tigers. Previously, the best way to estimate tiger ranges and populations was by looking for and analyzing their footprints, or pugmarks. Pugmarks can provide information about tiger size, sex, and territory, but they are not enough to obtain reliable data about entire tiger populations.



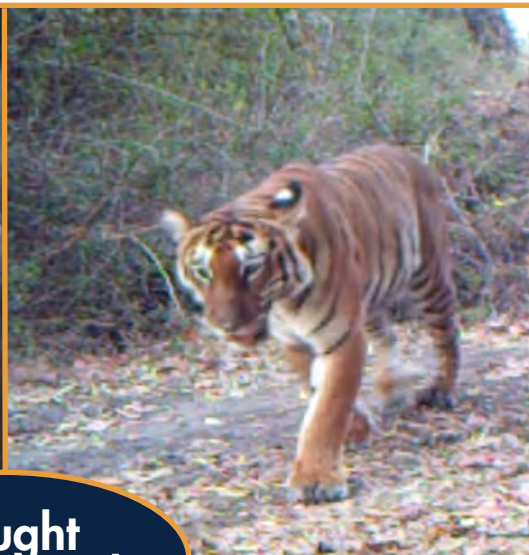
Today, scientists study tigers and other elusive forest animals by using "camera traps." These are remotely-triggered cameras that are set out in multiple areas of the forest for long periods of time. Each one has a sensor that detects movement and triggers the camera to take a picture, even at night. Every few months, the scientists go out and download the images. Each image has a stamp of the day and time the picture was taken.



Tigers have a special feature that makes identifying them a little bit easier - their striped coats. Each tiger has a unique pattern of stripes that is different from all other individuals, just like human fingerprints. Scientists use this trait to collect accurate data. The camera traps are placed at the right height to be sure to capture the stripe patterns of tigers in the photos.

Having cameras snapping pictures all over the forest for months at a time can generate a lot of data! How do you sort through all of the pictures and decide which pictures are of the same tiger? It used to be done by people and took a long time. Now computers can help. When the images are collected, a special computer program that uses **artificial intelligence** analyzes all the pictures and matches the individual stripes on the tigers. The computer can quickly identify each tiger. Then, it can help analyze patterns. But like any computer program, it took a lot of work to get the program to function just right. It was important to check the results of the computer to make sure it was sorting the images correctly. This **quality assurance** and **quality control** is an important step in programming.

Now, let's head to India to study tigers!



**Caught
on camera!**



GLOSSARY

ARTIFICIAL INTELLIGENCE

the development of computer systems that are able to perform tasks that normally require human intelligence

BIOME

a large ecosystem defined by its climate and the type of organisms that live in it

DIURNAL

active or occurring during the day

EXTINCTION

when a species or type of organism disappears forever

FERAL

once domesticated but now living in the wild

GENETIC VARIATION

the amount of genetic differences, or number of different genotypes, in a population

GENETICS

the study of heredity and the variation of inherited characteristics

HYBRID

the offspring of two different species

MIGRATE

to move from one area or habitat to another

NATIVE

naturally occurring in a place

QUALITY ASSURANCE

the maintenance of a desired standard in a service or product

QUALITY CONTROL

a system of maintaining standards in products by testing samples of the output

SEMIARID DESERT

a desert biome that has less extreme temperatures and more precipitation and vegetation than a hot and dry desert

SOLITARY

living alone

TERRITORY

an area defended by an animal against others of the same species

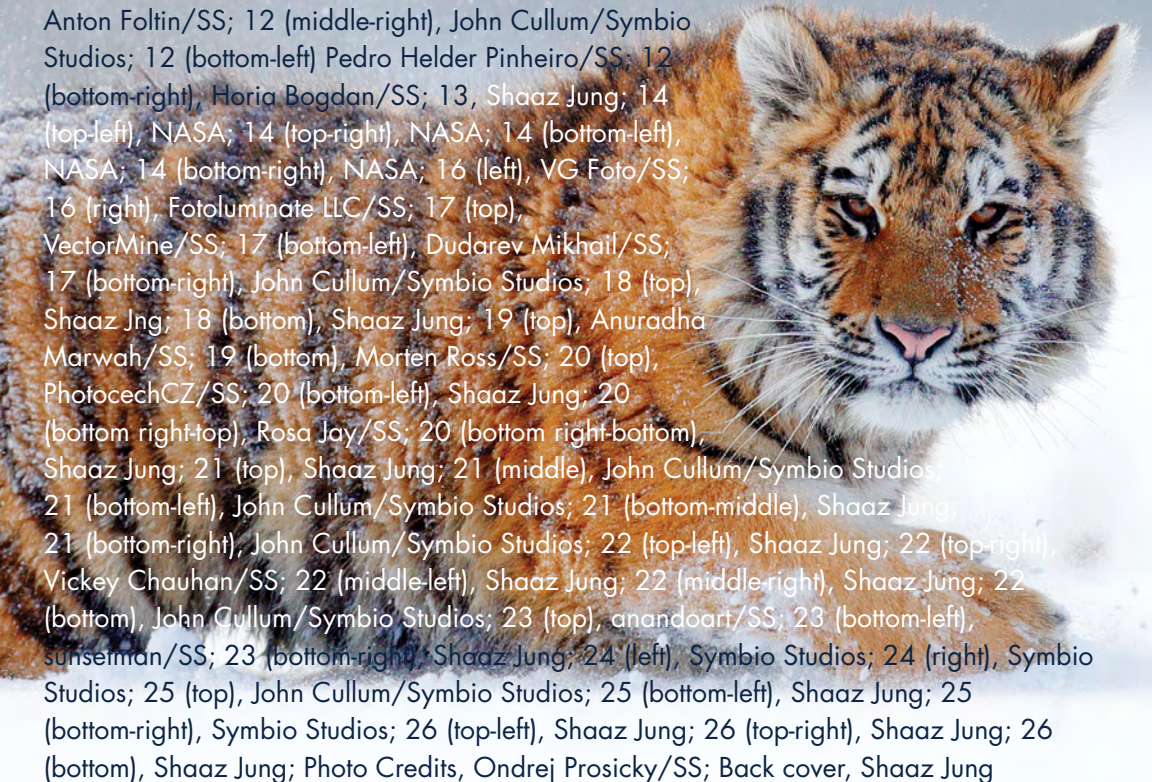
TRAIT

a feature passed down from parent to offspring

PHOTO CREDITS

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SCIENCE 3D

Thanks for exploring with us! Our science adventures take us around the world to uncover secrets of the most amazing animals and places. Our mission and passion is to share these scientific discoveries with you. There are so many cool things to see out there, even in your own backyard, so get outside and explore!

MIKE HEITHAUS PH.D.

Dr. Mike Heithaus is a scientist, explorer, author, educator, and television host. He is a professor of biology and Dean of the College of Arts, Sciences & Education at Florida International University. Mike and his students study sharks, whales, sea turtles, and other large marine animals around the world. They also work with people to help protect these species. Mike loves sharing his work with others. He has written text books and helped create programs for students in elementary, middle, and high school. He has been on television programs including on PBS, National Geographic, and Discovery Channel's Shark Week.



PATRICK GREENE

As a wildlife filmmaker, Patrick has always had a passion for animals. He started to draw pictures of sharks and whales when he was just five years old. Later, he went to college to become a marine biologist and learned a lot about science. Then he got a job in television and learned how to make videos, too. Since then, he's gone all over the world studying and filming wild animals. He's made shows for National Geographic, PBS and ABC, and even won an Emmy Award. He loves making videos to teach students about science and about the many creatures that share our world.





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